

Arawacus euptychia (Lepidoptera: Lycaenidae: Eumaeini) is no longer an obscure species

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Abstract. The taxonomy, morphology, distribution, and habitat of the poorly-known *Arawacus euptychia* are discussed. Sampling for one year in the Atlantic Forest of Northeast Brazil was conducted, and we obtained basic information about this species. The previously unknown female is described. Its genitalia bear papillae anales that are subterminally constricted, which supports the placement of this species in *Arawacus*. Adults are illustrated, and their wing patterns are compared with those of sympatric euptychiine butterflies from the nymphalid subfamily Satyrinae.

Key words: Butterfly, Brazilian Northeast, Euptychiina, butterfly wing pattern, false head hypothesis.

INTRODUCTION

The South American lycaenid butterflies *Arawacus euptychia* (Draudt, 1920) and *Evenus satyroides* (Hewitson, 1865) (Theclinae, Eumaeini) possess wing patterns that resemble those of *Euptychia* Hübner and other Satyrinae (Nymphalidae), as indicated by their specific names. Whereas *E. satyroides* is a widespread and relatively common species (Draudt, 1919-1920), *A. euptychia* is one of the more obscure butterfly species in South America. Although Draudt (1919-1920: 811) described *Thecla euptychia* "according to a ♂ from the Museu Paulista from South Brazil," the type specimen is not extant (Mielke & Casagrande, 1988; M. Duarte pers. comm.), and the species has not been recorded in lists of the south Brazilian butterfly fauna (e.g., Ebert, 1969; K. Brown, 1992; Duarte *et al.*, 2010). Indeed, no specimens were known until a putative male was found in 1991 by the junior author in the remote mountains of Bahia, Brazil (an image of this male was published in D'Abrera, 1995: 1137). Robbins (2000) transferred *Thecla euptychia* to

Arawacus Kaye based on similarity between the genitalia of this male and of the male of *Arawacus tadita*. However, generic placement was provisional because the sole morphological synapomorphy for *Arawacus* was the shape of the female papillae anales (Robbins, 2000). *Arawacus euptychia* was later recorded in a montane semi-deciduous forest fragment in Pernambuco, northeastern Brazil (Paluch *et al.*, 2011).

This paper has the following purposes related to the name *Arawacus euptychia*: 1) to explain the basis for the identification of the species; 2) to illustrate the morphology of the female; 3) to present evidence from the female morphology that confirms the generic placement of *A. euptychia* and that shows that this species is likely most closely related to *A. dumenilii* and *A. tadita*; 4) to document the distribution, habitat, and flight behavior of *A. euptychia*; and 5) to assess the biological significance of the resemblance in wing pattern between *A. euptychia* and sympatric Satyrinae butterflies.

MATERIALS AND METHODS

For the dissection of the female genitalia, the abdomen was boiled in a solution of 10% potassium hydroxide for five minutes. The genitalia were examined with a Leica EZ4D stereomicroscope and photographed with a built in digital camera. The terminology of the genitalia follows Klots (1970), as modified for the Eumaeini (Robbins, 1991). Wing vein names follow Comstock (1918), and the abbreviations FW and HW are used for forewing and hindwing, respectively.

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The following acronyms are used for museum collections where specimens of *A. euptychia* are deposited or that are mentioned in the text.

CE-UFPE — Coleção Entomológica, Universidade Federal de Pernambuco, Recife, Brazil

DZUP — Museu de Entomologia Pe. Jesus Santiago Mourem, Universidade do Paraná, Curitiba, Brazil

MF-CE — Coleção Entomológica do Museu de Fauna/Cemafauna, Universidade Federal do Vale do São Francisco, Petrolina, Brazil

MZUSP — Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil

SMF — Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany

USNM — National Museum of Natural History, Smithsonian Institution, Washington, DC, United States

Although the distribution of *A. euptychia* was based on specimens deposited in the collections just listed, most specimens of and information about *A. euptychia* resulted from a butterfly survey along the borders and understory trails (4:1 sampling hours) of six Atlantic Forest remnants located at the Usina São José S/A (USJ) (coordinates: 7°41'4.09" to 7°54'41.6"S; 34°05'17.6 to 35°05'07.2"W), a sugarcane industry facility situated in the municipality of Igarassu, northeastern Pernambuco, Brazil (Fig. 1). Butterflies were sampled from four to six days per month, from April/2007 to March/2008 for a total of approximately 300 net-sampling hours. This northeastern portion of Atlantic Forest is characterized as dense lowland rainforest (Veloso *et al.*, 1991) and has a more seasonal rainfall regime than the southeastern portion (Schessl *et al.*, 2008). The fragment sizes were from 12 to 387 ha with elevations ranging from 20 to 155 m a.s.l. The mean annual temperature from 1998 to 2007 was 24.9° C. Sampling time was from 08h00 to 12h00, and from 13h00 to 16h00, between April 2007 to March 2008. In the first six months, only four of the six fragments were sampled. Data on temperature and precipitation were available from weather stations operated by the USJ. The specimens from this survey are deposited in the entomological collection at CE-UFPE.

RESULTS AND DISCUSSION

Identification of the name *Thecla euptychia* Draudt

Draudt (1919-1920) described *Thecla euptychia*, *T. pura*, and *T. clarissa* from specimens in the "São Paulo museum." The types of the latter two names are in MUZSP, but the type of the first is not (Mielke

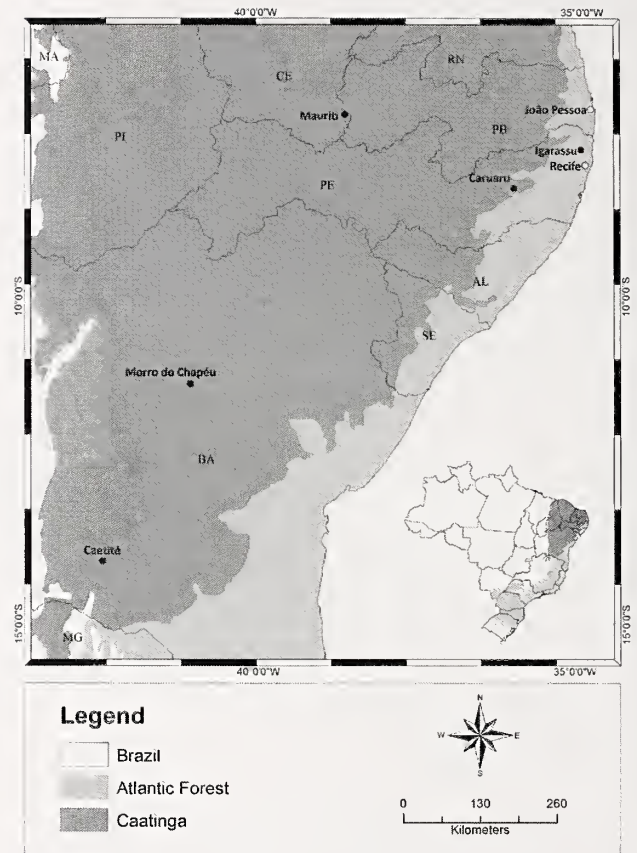
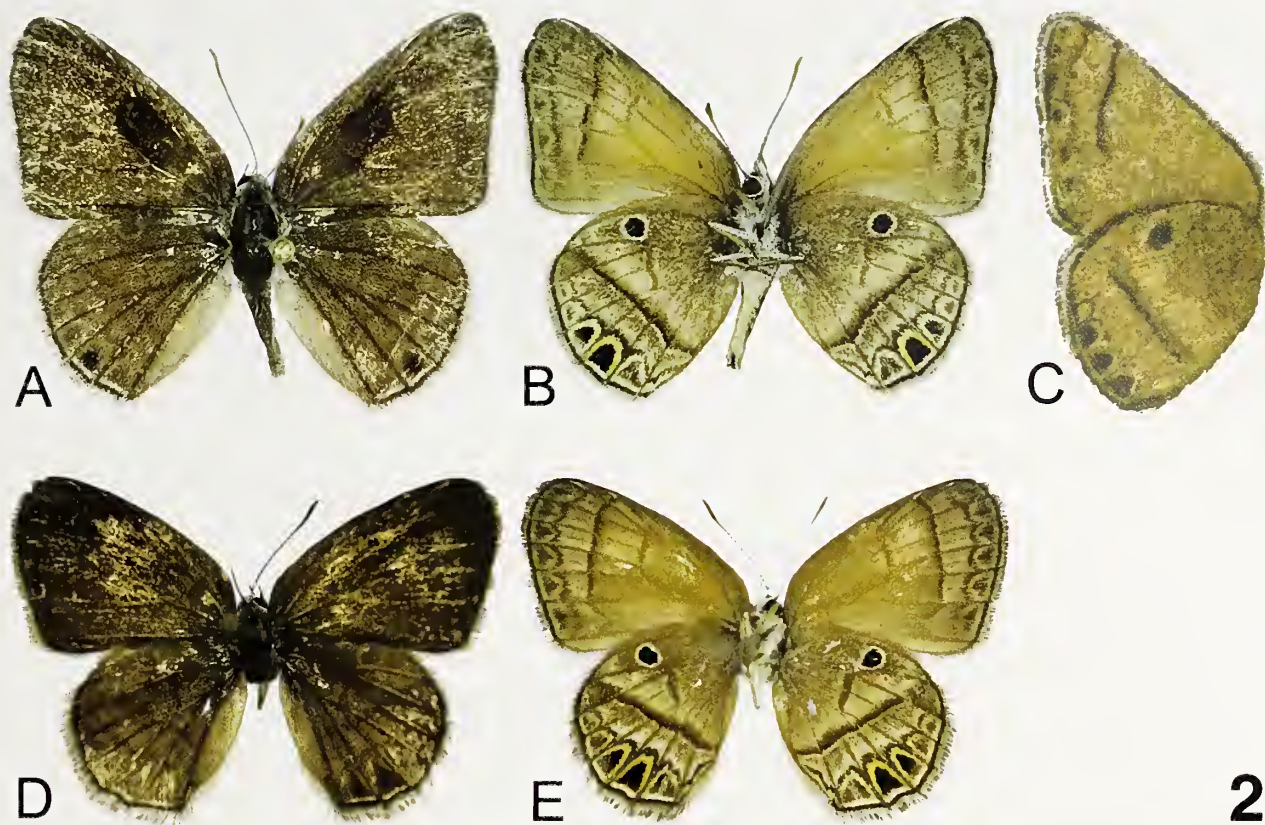


Figure 1. Distribution map for *Arawacus euptychia*. Black dots – occurrence localities; white dots – localities from which *A. euptychia* is unrecorded despite extensive survey work.

& Casagrande, 1988). The current curator of Lepidoptera, Marcelo Duarte, confirms that there is no type of *T. euptychia* in MZUSP. Many Draudt types in the Lycaenidae are deposited in Frankfurt (SMF), but the type of *T. euptychia* is not there either (Lamas & Robbins, in prep.). Without a type, the only information about this name is that contained in the original description.

The detailed original description of *Thecla euptychia* (Draudt, 1919-1920: 811) follows. "**Th. euptychia spec. nov.** (145 1) has the shape of *tadita*, but it is all brown with a black scent-spot, on the hindwing analwards a white border-line and between the median veins a small black spot bordered proximally with a light colour. Beneath the disc of the forewing is rusty yellow, distally brown-grey, the hindwing brown-grey, with the same marking as in the preceding, the costal-marginal eye-spot very large, jet-black, white-ringed, also the spot between the median veins and one above it jet-black, upwards with a golden yellow ring."



Figures 2-3. 2. Adults of *Arawacus euptychia*. Male: (A) dorsal, (B) ventral, (C) original illustration in Draudt (1920); female: (D) dorsal, (E) ventral. 3. Female genitalia of *Arawacus euptychia*. (A) dorsal aspect of papillae anales, posterior to left, showing subterminal constriction (arrow). (B) lateral aspect of ductus copulatrix, posterior to left, showing sclerotized pouch from which the ductus seminalis arises (arrow).

This written description fits the illustrated male (Figs. 2A, 2B) in all respects. In particular, the combination of rusty yellow at the base of the ventral forewing and the golden yellow ring around the submarginal spot on the ventral hind wing is definitive because it describes no other species of *Arawacus* or Eumaeini, so far as we are aware. We base our identification of the name primarily upon the written text because the original illustration was poor (Fig. 2C).

Female of *Arawacus euptychia*

Label: Igarassu - PE, Usina São José, Pezinho. Brasil, 22.05.2007. C.E.B. Nobre, leg. (Figs. 2D-2E).

Diagnosis. The female differs externally from the other sex only by the rounded apex of forewing and by the more triangular-shaped marginal eye-spots on the hindwing. **Wings:** FW length: 11.4 mm. Color pattern identical to that of males: dorsal ground color brown, border dark brown, fringe brown, medially light. HW with marginal white ray on Cu_1 and Cu_2 . Ventral ground color cream, with rusty yellow FW basal half. Two brown bars on both FW and HW: one postmedian from veins R_2 to Cu_1 and the other on distal margin of discal cell. FW with faint submarginal brown spots bordered by a light brown and a dark brown line, on cells R_2 to Cu_1 . HW with distinct postmedian band formed by white and brown scales and medial black spot bordered by white scales on cell Rs. Black somewhat triangular spots bordered proximally by yellow and then, brown scales and distally only by brown scales on cells M_3 and Cu_1 , the last one being larger. **Head:** Antennae (5.6 mm): brown, on the stalk ringed with white scales at base of each segment, but not on the dorsal surface. Nudum confined to the club. Eyes naked, golden brown bordered by white scales. Palpi white with scattered brown scales and last segment brown. **Body.** Thorax dorsally brown, ventrally white. Legs white, except on tibia and tarsi, which are tan.

Genitalia (Fig. 3): Tips of papillae anales black, heavily sclerotized, subterminally constricted at base (Fig. 3A), setae concentrating medially. Corpus bursae with a pair of hollow-pointed signa, longer than wide, projecting anteriorly; ductus seminalis arising from a pouch, dorsal to the ductus bursae, and fused to it anteriorly; ductus bursae bent at middle (Fig. 3B).

Systematic placement of *Arawacus euptychia*

Robbins (1991, 2000) distinguished *Arawacus* morphologically by subterminally constricted papillae anales and ecologically by caterpillars that eat the leaves of *Solanum* (Solanaceae). Although the larval food plant of *A. euptychia* remains unknown, the shape of the papillae anales is subterminally constricted (Fig. 3A, arrow). Further, the shape and sclerotization of the pouch of the corpus bursae (Fig. 3B) from which the ductus seminalis arises is indistinguishable from that in *A. dumenilii* and *A. tadita*. In *A. binangula*, the pouch is of a similar shape, but it is not as sclerotized as in *A. euptychia*. Finally, wing pattern elements

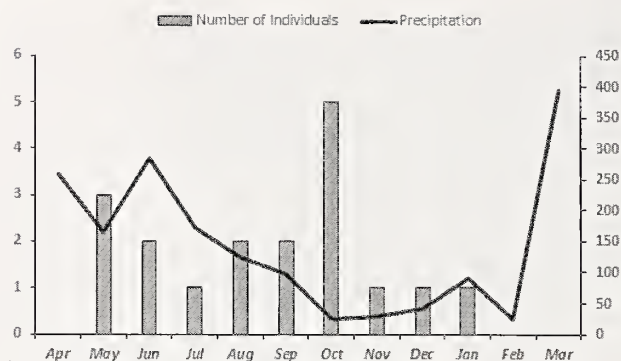


Figure 4. Number of individuals of *Arawacus euptychia* and monthly precipitation from April 2007 to March 2008 in the municipality of Igarassu, northeastern Pernambuco, Brazil.

of *A. dumenilii* and *A. tadita* are similar of those of *A. euptychia*. These results are consistent with the placement of *A. euptychia* in *Arawacus*, and it is likely that *A. dumenilii*, *A. euptychia*, and *A. tadita* form a clade within *Arawacus*.

Seasonality, distribution, habitat, and flight behavior of *A. euptychia*

In one year of sampling in the municipality of Igarassu, 18 individuals were recorded. The only female found was collected in a 30 ha remnant, at an approximate elevation of 100 meters. Species abundance was low throughout the year, and no obvious correlation was found between the number of individuals and monthly precipitation (Fig. 4).

The known distribution of *A. euptychia* is restricted to northeastern Brazil, but this species occurs in a variety of habitats. It has been recorded in montane Caatinga (Bahia: Caetitê at 850 m elevation, Morro do Chapeu at 1200 m and Ceará: Mauriti at 808 m), coastal Atlantic Forest near sea level (Pernambuco: Igarassu), and montane Atlantic Forest (Pernambuco: Caruaru, 8°21'45.36" S, 36°02'11.31" W at approximately 840 m, Paluch *et al.*, 2011). The last locality is called "brejo de altitude" (altitude wetland), a site of humid forest surrounded by semi-arid Caatinga vegetation (Andrade-Lima, 1982). Despite the varied habitats in which *A. euptychia* has been found, its occurrence is hard to predict. For example, it was not recorded in two large urban forest remnants of Paraíba (Mata do Buraquinho, 7°08'42" S, 34°51'34" W; Kesselring & Ebert, 1982) and Pernambuco (Parque Estadual Dois Irmãos, 8°00'31" S, 34°56'53" W; D.H. Melo,

Table 1. Species of Euptychiina sympatric with *Arawacus euptychia* in the state of Pernambuco, Brazil. ¹Atlantic Forest (C.E.B. Nobre, unpublished); ²Montane wetland (Paluch *et al.*, 2011); ³Caatinga (Nobre *et al.*, 2008).

Species	Locality		
	Igarassu ¹	Caruaru ²	Catimbau National Park ³
<i>Chloreuptychia amaca</i> (Fabricius, 1776)		x	
<i>Cissia myncea</i> (Cramer, 1780)	x	x	
<i>Cissia palladia</i> (A. Butler, 1867)	x		
<i>Cissia terrestris</i> (A. Butler, 1867)	x		
<i>Erichthodes antonina</i> (C. & R. Felder, 1867)	x		
<i>Euptychoides castrensis</i> (Schaus, 1902)	x		
<i>Hermeuptychia atalanta</i> (Butler, 1867)		x	
<i>Hermeuptychia gr.hermes</i> (Fabricius, 1775)	x		x
<i>Magneuptychia libye</i> (Linnaeus, 1767)	x	x	
<i>Pareuptychia ocirrhoe interjecta</i> (D'Almeida, 1952)	x	x	
<i>Paryphthimoides poltys</i> (Prittwitz, 1865)		x	
<i>Pharneuptychia innocentia</i> (C. & R. Felder, 1867)			x
<i>Pharneuptychia phares</i> (Godart, [1824])			x
<i>Yphthimoides affinis</i> (A. Butler, 1867)	x	x	
<i>Yphthimoides manasses</i> (C. & R. Felder, 1867)		x	
<i>Yphthimoides ochracea</i> (A. Butler, 1867)		x	
<i>Yphthimoides renata</i> (Stoll, 1780)	x	x	
<i>Zischkaia</i> sp.	x		

pers. comm.), although both areas are similar in their vegetation to the forest remnants of northern Pernambuco (Fig. 1).

Wing pattern of *A. euptychia* and sympatric satyrine butterflies

Unlike many *Arawacus* and other Eumaeini species, the wings of *A. euptychia* do not possess the components of a “false head” wing pattern (Robbins, 1980, 1981). Rather, the ventral wing pattern of this species is more like that of sympatric euptychiine butterflies (Nymphalidae: Satyrinae: Euptychiina) in the state of Pernambuco (Table 1), especially the genus *Pharneuptychia*. This genus occurs in open habitats and forest edges, and is one of the few Euptychiina that are common in dry forests, such as the Caatinga. In particular, the species *P. phares* and *P. innocentia* (Nobre *et al.*, 2008; Kerpel *et al.*, 2013) are about the same size as *A. euptychia* and have rusty yellow scales at the base of the ventral forewing.

The flight behavior of *A. euptychia* also appears to be similar to that of euptychiine butterflies. DeVries (1987) described the flight of euptychiines as “a characteristic bouncy flight,” but in contrast, we would describe the typical flight of eumaeine lycaenids as rapid and

directed. The male of *A. euptychia* from Morro do Chapeu was flying through short grass at the edge of a dirt road. It was flying with satyrine butterflies, and was flying like a typical satyrine. In Igarassu, the adults were found at forest borders, in sunny sites.

CONCLUSIONS

Arawacus euptychia was an obscure species because it occurs in the northeast of Brazil, where the butterfly fauna is more poorly documented than in the south, and because its occurrence within its range appears to be unpredictable. Female morphology provides evidence that it is correctly placed in *Arawacus* and that it is closely related to *A. dumenilii* and *A. tadita*. The characters given in the original description accurately distinguish *A. euptychia* from these two relatives. The wing pattern, habitat, and flight behavior of *A. euptychia* seem to closely match that of sympatric satyrines, especially those in the genus *Pharneuptychia*. Perhaps there is an advantage to resembling common species in a habitat, such as *Pharneuptychia*, but otherwise, the reasons why *A. euptychia* would have a euptychiine-like wing pattern are yet to be determined.

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